

- 21 -

CLAIMS

1. An apparatus for processing a microelectronic workpiece, the apparatus comprising:
 - a workpiece support adapted to hold the microelectronic workpiece;
 - a processing container adapted to receive the microelectronic workpiece held by the workpiece support;
 - a drive mechanism connected to drive the processing container and the workpiece support holding the microelectronic workpiece relative to each other so that the microelectronic workpiece may be moved to a plurality of workpiece processing positions;
 - a first chemical delivery system providing at least one processing fluid to the processing container for application to the microelectronic workpiece when the microelectronic workpiece is in a first one of the plurality of workpiece processing positions;
 - a first chemical collector system adapted to assist in at least partially removing spent processing fluid provided by the first chemical delivery system while the microelectronic workpiece is in the first one of the plurality of workpiece processing positions;
 - a second chemical delivery system providing at least one processing fluid to the processing container for application to the microelectronic workpiece when the microelectronic workpiece is in a second one of the plurality of

- 22 -

microelectronic workpiece processing positions, the second chemical delivery system directing a spray of processing fluid for initial contact with the microelectronic workpiece at an initial radial position;

a second chemical collector system adapted to assist in at least partially removing spent processing fluid provided by the second chemical delivery system from the processing container while the microelectronic workpiece is in the second one of the plurality of microelectronic workpiece processing positions;

a control system connected to direct the drive mechanism to move the workpiece support during application of the spray from the second chemical delivery system so as to vary the radial position of the initial contact between the spray and the microelectronic workpiece.

2. An apparatus as claimed in claim 1 and further comprising a rotor drive connected to spin the workpiece support and corresponding microelectronic workpiece.
3. An apparatus as claimed in claim 1 wherein the first one of the plurality of workpiece processing positions is at a first vertical level within the processing container and the second one of the plurality of workpiece processing positions is at a second vertical level within the processing container, the second vertical level being above the first vertical level.

- 23 -

4. An apparatus as claimed in claim 3 wherein the first chemical collector system is disposed at a vertical level of the processing container corresponding to the first one of the plurality of workpiece processing positions and the second chemical collector system is disposed at a different vertical level of the processing container that corresponds to the second one of the plurality of workpiece processing positions.
5. An apparatus as claimed in claim 2 wherein the second chemical collector system collects spent processing fluid as the spent processing fluid is flung from the microelectronic workpiece during spinning of the microelectronic workpiece by the rotor drive.
6. An apparatus as claimed in claim 5 wherein the second chemical collector system comprises:
 - a splash wall extending about the interior periphery of the processing container;
 - a further wall extending about the interior periphery of the processing container;
 - the splash wall and further wall defining a collection channel therebetween for collecting the spent processing fluid of the second chemical delivery system.

- 24 -

7. An apparatus as claimed in claim 6 and further comprising a fluid outlet proceeding from the collection channel.
8. An apparatus as claimed in claim 1 wherein the control system directs the drive mechanism to drive the microelectronic workpiece to a plurality of positions as the second chemical delivery system provides the at least one processing fluid for contact with the microelectronic workpiece.
9. An apparatus as claimed in claim 8 wherein the second chemical collector system comprises:
 - a splash wall extending about the interior periphery of the processing container;
 - a further wall extending about the interior periphery of the processing container;
 - the splash wall and further wall defining a collection channel therebetween for collecting the spent processing fluid of the second chemical delivery system.
10. An apparatus as claimed in claim 8 wherein the second chemical delivery system directs a stream of the at least one processing fluid toward a fixed location.

- 25 -

11. An apparatus for processing a microelectronic workpiece, the apparatus comprising:

a workpiece support adapted to hold the microelectronic workpiece;

a processing container adapted to receive the microelectronic workpiece held by the workpiece support;

an automated drive system connected to drive the processing container and the workpiece support holding the microelectronic workpiece relative to each other so that the microelectronic workpiece is moved between an initial processing position and a secondary processing position;

a chemical delivery system providing at least one stream of at least one processing fluid to the processing container for application to at least one surface of the microelectronic workpiece as the microelectronic workpiece proceeds between the initial processing position and secondary processing position, the at least one stream being directed toward a central portion of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is in the initial processing position, the at least one stream being directed toward a peripheral portion of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is in the secondary processing position.

12. An apparatus as claimed in claim 11 wherein the automated drive system comprises a linear actuator that drives the processing container and the

- 26 -

workpiece support relative to each other along a vertically oriented drive path.

13. An apparatus as claimed in claim 11 wherein the automated drive system comprises a rotational actuator that drives the processing container and the workpiece support relative to each other along an angular drive path.
14. An apparatus as claimed in claim 11 and further comprising a chemical collector system adapted to remove spent processing fluid provided by the chemical delivery system as the microelectronic workpiece proceeds between the initial processing position and the secondary processing position.
15. An apparatus as claimed in claim 14 and further comprising:
 - a further chemical delivery system providing at least one processing fluid to the processing container for application to the microelectronic workpiece when the microelectronic workpiece is in a further processing position other than a position between the initial and secondary processing positions;
 - a further chemical collector system adapted to assist in at least partially removing spent processing fluid provided by the further chemical delivery system

- 27 -

from the processing container while the microelectronic workpiece is in the further workpiece processing position.

16. An apparatus as claimed in claim 14 wherein the chemical collector system comprises:

a splash wall extending about the interior periphery of the processing container;
a further wall extending about the interior periphery of the processing container;
the splash wall and further wall defining a collection channel therebetween for collecting the spent processing fluid of the further chemical delivery system.

17. An apparatus as claimed in claim 11 and further comprising a rotor drive connected to spin the workpiece support and corresponding microelectronic workpiece as the microelectronic workpiece proceeds from the initial processing position to the secondary processing position.

18. An apparatus as claimed in claim 14 and further comprising a rotor drive connected to spin the workpiece support and corresponding microelectronic workpiece as the microelectronic workpiece proceeds from the initial processing position to the secondary processing position, the chemical collector system being adapted to collect spent processing

- 28 -

fluid as the microelectronic workpiece proceeds from the initial processing position to the secondary processing position.

19. An apparatus as claimed in claim 18 wherein the chemical collector system comprises:

a splash wall extending about the interior periphery of the processing container;
a further wall extending about the interior periphery of the processing container;
the splash wall and further wall defining a collection channel therebetween for collecting the spent processing fluid of the chemical delivery system.

20. An apparatus for processing a microelectronic workpiece, the apparatus comprising:

a workpiece support adapted to hold the microelectronic workpiece;
a processing container adapted to receive the microelectronic workpiece held by the workpiece support, the processing container being adapted for immersion processing of at least one surface of the microelectronic workpiece at a first processing portion of the processing container, and adapted for spray processing the at least one surface of the microelectronic workpiece at a second processing portion of the processing container;
a drive mechanism connected to drive the processing container and the workpiece support holding the microelectronic workpiece relative to each other so

- 29 -

that the microelectronic workpiece may be moved to a plurality of workpiece processing positions, the plurality of workpiece processing positions including at least an immersion processing position proximate the first portion of the processing container and a spray processing position proximate the second portion of the processing container;

a first chemical delivery system providing at least one processing fluid to the processing container for immersion processing of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is at the immersion processing position;

a first chemical collector system adapted to assist in at least partially removing spent processing fluid provided by the first chemical delivery system while the microelectronic workpiece is at the immersion processing position;

a second chemical delivery system providing at least one processing fluid to the processing container for spray processing of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is at the spray processing position, the second chemical delivery system directing a spray of processing fluid for initial contact with the microelectronic workpiece at an initial radial position;

a second chemical collector system adapted to assist in at least partially removing spent processing fluid provided by the second chemical delivery system

- 30 -

from the processing container while the microelectronic workpiece is at the spray processing position;

a control system connected to direct the drive mechanism to move the workpiece support during application of the spray from the second chemical delivery system so as to vary the radial position of the initial contact between the spray and the microelectronic workpiece.

21. An apparatus as claimed in claim 20 wherein the first processing portion of the processing container is vertically below the second processing portion of the processing container.
22. An apparatus as claimed in claim 20 and further comprising a rotor drive connected to spin the workpiece support and corresponding microelectronic workpiece.
23. An apparatus as claimed in claim 20 wherein the immersion processing position is at a first vertical level within the processing container and the spray processing position is at a second vertical level within the processing container, the second vertical level being above the first vertical level.

- 31 -

24. An apparatus as claimed in claim 22 wherein the second chemical collector system collects spent processing fluid as the spent processing fluid is flung from the microelectronic workpiece during spinning of the microelectronic workpiece by the rotor drive.

25. An apparatus as claimed in claim 24 wherein the second chemical collector system comprises:

a splash wall extending about the interior periphery of the processing container;

a further wall extending about the interior periphery of the processing container;

the splash wall and further wall defining a collection channel therebetween for collecting the spent processing fluid of the second chemical delivery system.

26. An apparatus as claimed in claim 25 and further comprising a fluid outlet proceeding from the collection channel.

27. An apparatus as claimed in claim 21 wherein the drive mechanism comprises a linear actuator and wherein the control system directs the linear actuator to drive the microelectronic workpiece along a vertically

- 32 -

oriented linear drive path between the initial spray processing position and the secondary spray processing position.

28. An apparatus as claimed in claim 21 wherein the drive mechanism comprises a rotational actuator and wherein the control system directs the rotational actuator to rotate the microelectronic workpiece along an angular drive path about a fixed rotation axis between the initial spray processing position and the secondary spray processing position.

29. An apparatus as claimed in claim 21 wherein the second chemical collector system comprises:

a splash wall extending about the interior periphery of the processing container;
a further wall extending about the interior periphery of the processing container;
the splash wall and further wall defining a collection channel therebetween for collecting the spent processing fluid of the second chemical delivery system.

30. An apparatus for electroplating a microelectronic workpiece, the apparatus comprising:

a workpiece support adapted to hold the microelectronic workpiece and to provide electroplating power to the microelectronic workpiece;

- 33 -

a processing container adapted to receive the microelectronic workpiece held by the workpiece support, the processing container including an interior container receiving an electroplating solution and an outer container receiving spent electroplating solution that overflows from the interior container;

a drive mechanism connected to drive the processing container and the workpiece support holding the microelectronic workpiece relative to each other so that the microelectronic workpiece may be moved to at least a first position at which at least one surface of the microelectronic workpiece contacts the electroplating solution in the interior container and a second position at which the microelectronic workpiece is elevated from contact with the electroplating solution;

a second chemical delivery system providing a stream of at least one processing fluid to the processing container for spray processing of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is at the second position;

a chemical collector system disposed at an interior periphery of the processing container to assist in at least partially removing spent processing fluid provided by the second chemical delivery system from the processing container, the chemical collector system further assisting to prevent mixing of the at least one processing fluid provided by the second

- 34 -

chemical delivery system with the electroplating solution disposed in the interior container and exterior container; and

a control system connected to the drive mechanism to move the workpiece support during application of the stream from the second chemical delivery system so as to vary the radial position of the initial contact between the stream and the microelectronic workpiece.

31. An apparatus as claimed in claim 30 and further comprising a rotor drive connected to spin the workpiece support and corresponding microelectronic workpiece to thereby fling spent processing fluid into the chemical collection system.

32. An apparatus as claimed in claim 31 wherein the chemical collector system comprises:

a splash wall extending about the interior periphery of the processing container;
a further wall extending about the interior periphery of the processing container;
the splash wall and further wall defining a collection channel therebetween for collecting the spent processing fluid of the chemical delivery system.

33. An apparatus as claimed in claim 32 and further comprising a fluid outlet proceeding from the collection channel.

- 35 -

34. An apparatus as claimed in claim 32 wherein the control system directs the drive mechanism to drive the microelectronic workpiece between an initial spray processing position and a secondary spray processing position as the chemical delivery system provides the at least one fixed stream of processing fluid for contact with the at least one surface of the microelectronic workpiece, the at least one fixed stream being directed toward a central portion of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is in the initial spray processing position, the at least one stream being directed toward a peripheral portion of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is in the secondary spray processing position.
35. An apparatus as claimed in claim 34 wherein the drive mechanism comprises a linear actuator and wherein the control system directs the linear actuator to drive the microelectronic workpiece along a vertically oriented linear drive path between the initial spray processing position and the secondary spray processing position.
36. An apparatus as claimed in claim 34 wherein the drive mechanism comprises a rotational actuator and wherein the control system directs the

- 36 -

rotational actuator to rotate the microelectronic workpiece along an angular drive path about a fixed rotation axis between the initial spray processing position and the secondary spray processing position.

37. An apparatus for processing a microelectronic workpiece, the apparatus comprising:

a workpiece support adapted to hold the microelectronic workpiece;

a processing container adapted to receive the microelectronic workpiece held by the workpiece support;

a drive mechanism connected to drive the processing container and the workpiece support holding the microelectronic workpiece relative to each other so that the microelectronic workpiece may be moved to a plurality of workpiece processing positions;

a plurality of chemical delivery systems providing a corresponding plurality of processing fluids to the processing container for application to the microelectronic workpiece when the microelectronic workpiece is moved to a plurality of workpiece processing positions;

a plurality of chemical collector systems respectively corresponding to the plurality of chemical delivery systems, each of the plurality of chemical collector systems being adapted to assist in at least partially removing

- 37 -

spent processing fluid provided by the corresponding chemical delivery system.

38. An apparatus for processing a microelectronic workpiece, the apparatus comprising:

a workpiece support adapted to hold the microelectronic workpiece;

a processing container adapted to receive the microelectronic workpiece held by the workpiece support;

an automated drive system connected to drive the processing container and the workpiece support holding the microelectronic workpiece relative to each other so that the microelectronic workpiece is moved between an initial processing position and a secondary processing position;

a chemical delivery system providing at least one stream of at least one processing fluid to the processing container for application to at least one surface of the microelectronic workpiece as the microelectronic workpiece proceeds between the initial processing position and secondary processing position, the at least one stream being directed toward a first radial portion of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is in the initial processing position, the at least one stream being directed toward a second radial portion of the at least one surface of the microelectronic workpiece when the microelectronic workpiece is in the secondary processing position.